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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/30, G10L 5/00

A1

(11) International Publication Number: WO 96/00483

(43) International Publication Date: 4 January 1996 (04.01.96)

(21) International Application Number: PCT/EP95/02378

(22) International Filing Date: 20 June 1995 (20.06.95)

(30) Priority Data:
9412583.8 23 June 1994 (23.06.94) GB

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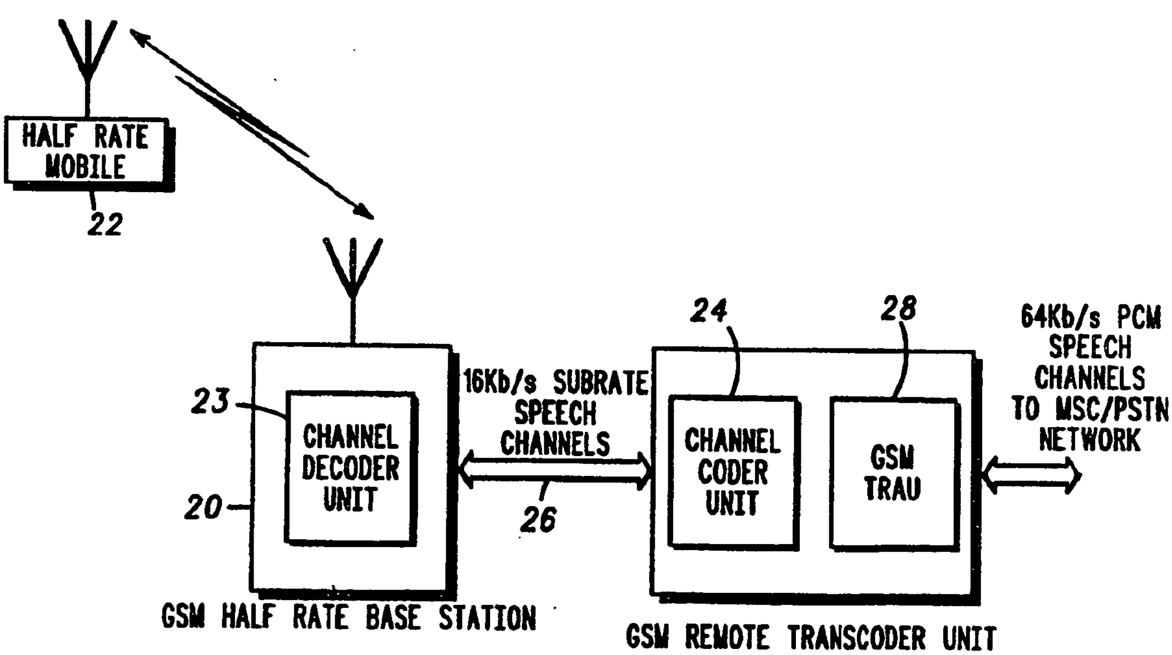
(81) Designated States: CN, KR, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: TRANSCODING AND CHANNEL CODING ARRANGEMENT FOR A DIGITAL COMMUNICATIONS SYSTEM



(57) Abstract

A communications system is provided having a transcoder unit (28) located at a first site, a channel coder unit (24) for communication with the transcoder unit (28) also located at the first site, and a channel decoder unit (23) for communication with the transcoder unit (28) over a communications link (26) where the channel decoder unit is (23) located at a second site separate from the first site. According to a preferred embodiment of the present invention the transcoder, channel coder and the channel decoder units operate in a half rate mode.

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TRANSCODING AND CHANNEL CODING ARRANGEMENT FOR A DIGITAL COMMUNICATIONS SYSTEM

Field of the Invention

This invention relates in general to communications systems, and more particularly to a communications system for providing a channel coder unit and a transcoder unit remotely from a channel decoder unit.

Background to the Invention

In digital communications systems there are components that encode and decode speech for communications over radio frequencies. In GSM (Global System for Mobile Communications) a speech transcoder provides the encoding and decoding ability in one component and is sometimes referred to as a speech codec. The speech codec includes both speech coder and speech decoder modules. Similarly, there is a channel codec for encoding and decoding additional information and data to the speech for transmitting and receiving over the air.

In the current GSM Digital Cellular Radio System, the speech codec delivers 13 kbits of compressed speech to the channel codec, which in turn delivers 22.8 kbits to the radio frequency (RF) path. This is call a full rate service type. Being planned is half rate speech service, where a half rate speech codec will deliver about 6 kbits to a half rate channel codec, which in turn will deliver 11.4 kbits to the RF path.

The channel codec, including both a channel coder and channel decoder, is usually at the Base Transceiver Site (BTS) site, whereas the speech codec can be at the BTS, Base Station Controller (BSC) or Mobile Switching Centre (MSC) sites. When the speech codec is not at the BTS site, GSM specifies the interface or protocol that must be used between the remote speech codec and the channel codec. Such an interface exists for full rate (GSM 08.60) and is being planned for half rate (either GSM 08.60 or new document).

In the case of full rate, the transcoder converts between 64 kbits and 16 kbits (13 kbits plus 3 kbits control) and the channel coder then brings this rate up to 22.8 kbits over the air interface.

In the case of half rate, although the transcoder to channel coder intermediate rate is not known as yet (it may however be 8 kbits and or 16

kbits including control), the net conversion performed between the switch and the air interface is known to be between 64 kbits and 11.4 kbits.

GSM specification 03.05 recommends a particular maximum delay that may be tolerated for each entity that forms a part of the speech path. There are figures for the algorithm delay that a typical implementation of a speech coder, speech decoder, channel coder, channel decoder (a composite figure) should exhibit and also delays for transfer of data between these coders/decoders.

When the transcoder is remote, the interface between the speech coder and channel coder is specified in GSM Recommendation 08.60 for full rate. In this interface there are 320 bits per speech frame and the bandwidth is 16 kbits. Out of these 320 bits per speech frame, 260 bits make up the speech data and the rest are control bits.

Both full and half rate channel coders need all the speech parameters or bits associated with the same speech frame before they can start their channel coding algorithm. Hence, when a transcoder is remote, there will exist a delay in the system that is there just in order to transfer data from the remote speech coder to the channel coder. It takes over 17ms (Tabisd, as per GSM 03.05) in full rate to transfer all the speech data from the speech to channel coder. This amounts to the second largest delay figure associated with the GSM system (in terms of a delay experienced during a call). Similarly, a relatively substantial delay exists in half rate to transfer all the speech data required from the transcoder to the channel coder before the channel coder can begin its algorithm.

When the transcoder is at the same site as the channel codec, this transfer can be much faster as the link to the channel coder is not limited to 8 or 16 kbits as in the remote transcoder case. It can be as fast as the manufacturer desires. Specifically, when the transcoder is at the channel coder site, the maximum delay the speech coder can exhibit is equal to the time it takes to produce all the speech parameters for the frame, a figure of 8.0 ms (Ttransc as per GSM 03.05).

When the transcoder is located remotely the speech coder delay is specified by GSM to be the time to generate the first parameters (Tsps) in order to minimise the effects of a large transfer delay.

The difference between the two delay criteria for the speech coder located at the channel coder site versus the speech coder located at a

remote site leads to the need of much faster processors for the speech coder at the remote site than the speech coder at the channel coder site.

A further problem is caused as the speech decoder is also specified to meet a delay budget that is based on the output of PCM samples as early as possible, rather than once all PCM samples related to a frame are ready.

Hence, the manufacturer has to make sure that both speech coder and speech decoder delay budgets are met under all cases. (There is no known alignment between speech coder and speech decoder, and the worst case of alignment is when both speech coder and speech decoder need to be scheduled at the same time in order to generate the first parameters and output the first PCM samples).

Hence, a remote transcoder works harder than a transcoder located at the channel coder site as the remote transcoder needs to compensate for the larger transfer delay that is present in the remote case.

FIG. 1 shows a diagram representation of a half rate communication. A mobile station 12 communicates over radio frequencies to a base station 10. The base station 10 includes a channel codec 15. The channel codec 15 includes a channel coder unit 14 and a channel decoder unit 13. The channel codec 15 communicates via 16 Kb/s subrate speech channels 16 (link) to a transcoder 18 located remotely from the channel codec 15. The transcoder 18 then communicates to a mobile switching centre or public switched telephone network via 64 Kb/s PCM speech channels.

In a downlink communication (from the network to the mobile station) the channel coder unit 15 cannot begin its algorithm until a full speech frame has been received over the 16 Kb/s link 16 from the transcoder 18. Thus, there is a significant delay built in a downlink communication just waiting for a full speech frame to be received.

It is desirable to minimise the transfer delay exhibited between the transcoder 18 and the channel coder unit 14 when the transcoder 18 is located remotely from the channel coder unit 14.

Summary of the Invention

According to the present invention a communications system is provided having a transcoder unit located at a first site, a channel coder unit for communication with the transcoder unit also located at the first site, and a channel decoder unit for communication with the transcoder

unit over a communications link where the channel decoder unit is located at a second site separate from the first site.

According to a preferred embodiment of the present invention the transcoder, channel coder and the channel decoder units operate in a half rate mode.

Brief Description of the Drawing

FIG. 1 shows a block diagram of a prior art half rate communications system.

FIG. 2 shows a block diagram of a half rate communications system according to the present invention.

Detailed Description of the Preferred Embodiment

Referring to FIG. 2, a half rate communications system is shown including a mobile station 22, a base station 20, and a remote transcoder unit 28. The base station 20 includes a channel decoder unit 23. A channel coder unit 24 is located at the same site as the transcoder unit 28. Thus, the channel coder unit 24 is located at the remotely located speech codec 28 site.

An advantage of locating the channel coder unit 24 at the remote transcoder site with the remote transcoder 28 is that the transfer time between the channel coder unit 24 and the remote transcoder 28 is now minimised. Particularly when assuming that, like in the transcoder at the BTS site, the channel coder to transcoder interface may be made much faster than when the transcoder is remote. This makes this gained transfer time (Tabisd) available for the algorithms (in effect Tsps has now increased) and hence, due to the size of the figure gained (between 7ms and 17ms), can be used to realise the channel and speech coder using slower processors.

Another advantage is improved speech quality as the serial link between the base station 20 and switch is now error protected (channel coded speech), whereas it was not in the prior art case (raw speech).

The justification for the loss in the transfer delay is that the data for transmission to the air can be transferred to the base station 20 with limited buffering (much less than 17 ms). Further, since the air net rate is 11.4 kbits, this can be accommodated inside the 16 kbits bandwidth which is available in the link 26 between the remote transcoder 28 and the base

site 20. A similar situation does not exist for the GSM full rate case if it is essential not to use more than 16 kbits capacity per call between transcoder 28 and base site 20. Thus, depending upon the link (26) capacity, the present invention is not limited to half rate communications systems.

The present invention provides a new mix of the speech codec 28 and channel coder 24 when the speech codec 28 is remote from the BTS site 20.

The present invention also provides a more robust interface between the combined speech codec/channel coder 28, 24 and the BTS site 20. There is a reduction in the processing power required to implement the half rate algorithm or channel coder algoithm due to the freeing of a pre-set transfer delay, making it now available for processing. Alternatively, the availability of extra processing time could be used to increase of the number of channels that could be supported by a processor.

By transferring the channel coder 24 to the remote transcoder 28 site, there is a gain in the Tabisd delay figure as specified by GSM 03.05. This gain may then be applied to reduce the processing requirements of a half rate implementation and or can be used to increase the number of channels supported by an implementation.

Claims

1. A communications system for providing a digital communications service type, the communications system comprising:

transcoder unit located at a first site;

channel coder unit for communication with the transcoder unit and located at the first site;

channel decoder unit for communication with the transcoder unit over a communications link wherein the channel decoder unit is located at a second site separate from the first site.

2. The communications system of claim 1 where the communications link communicates at least 11.4 Kb/s subrate.

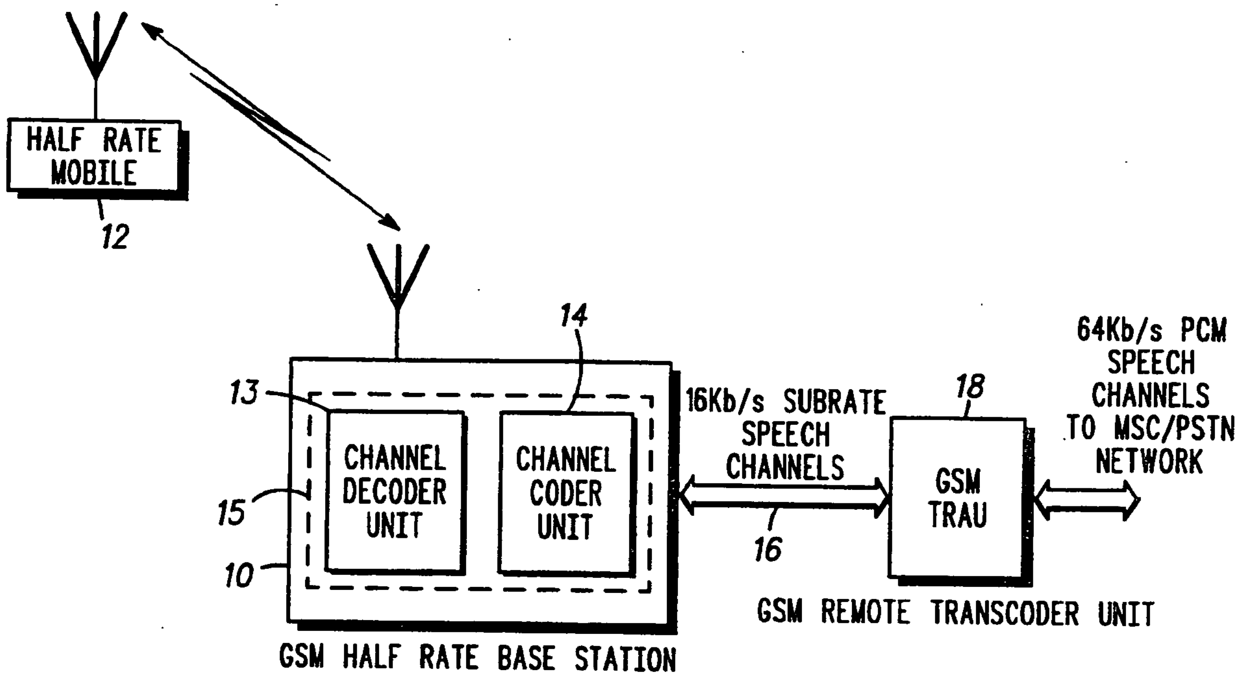
3. The communications system of any of the preceding claims wherein the second site is a base station site.

4. The communications system of any of the preceding claims wherein the first site is a switch site or a base station controller site.

5. The communications system of any of the preceding claims wherein the digital communications service is a half rate service.

6. The communications system of any of the preceding claims wherein the digital communications service is a half rate service specified by GSM.

7. The communications system of any of the preceding claims wherein the transcoder, channel coder and the channel decoder units operate in a half rate mode.



-PRIOR ART-

FIG.1

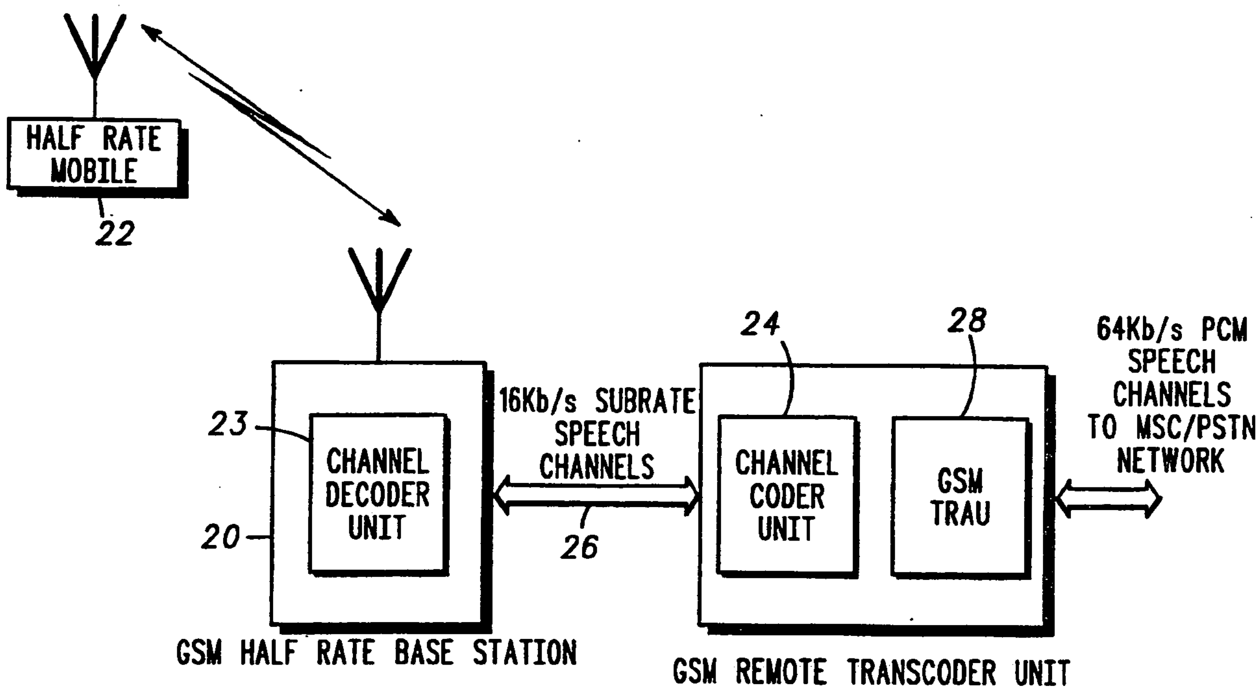


FIG.2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 95/02378

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/30 G10L5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q G10L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP-A-0 489 993 (MOTOROLA, INC.) 17 June 1992 see column 1, line 51 - column 3, line 26 see column 4, line 15 - line 24 see column 5, line 39 - column 7, line 14 ---	1,3,4
A	DIGITAL CELLULAR RADIO CONFERENCE, October 1988 HAGEN, DE, pages 5b/1-5b/11, H. ROSENLUND 'THE BASE TRANSCEIVER STATION (BTS) TO BASE STATION CONTROLLER INTERFACE A-BIS' see page 5b/3, line 21 - line 25 see page 5b/4, line 23 - page 5b/5, line 16 -----	1,3,4

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

.nformation on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-489993	17-06-92	US-A- 5077741	31-12-91